

Chapter 2

Technology Environment

Learning Objectives

At the conclusion of this chapter, the reader will be able to

- Articulate characteristics of applications commonly used in healthcare organizations (e.g., clinical, administrative, financial, consumer, business intelligence)
- Articulate characteristics of technology infrastructure that support the healthcare environment (e.g., network, communications, data integration, privacy and security)

Introduction

The world now is steered by technology and computers—from social networks to IoT (Internet of Things) devices, everything we interact with has a computer in the process. Healthcare may have been a little bit slower than other industries to adopt information technology (IT), but now the electronic health record (EHR) is an essential part of every facility that provides care to patients—from population health to the intensive care unit. Patients are no longer surprised when the provider pulls out a tablet computer instead of a paper chart and pen.

Most hospitals and outpatient sites provide wireless networks for staff to use in caring for patients and a different network for family and visitors to access. It is common to see patients updating their status on Facebook, reviewing their care plan from their hospital beds or checking in for their outpatient visit using their smartphone. Where hospitals used to have policies forbidding employees from accessing social networks during working hours, many institutions now employ staff to monitor and update social media sites. Many patients have

personal health records (PHRs) they manage online, as well as access to a patient portal through the facility's EHR system. Healthcare IT is changing the way that healthcare does business, as well as the way that clinicians care for patients. An understanding of the attributes of healthcare IT, as well as knowledge of the applications and hardware required for their use, is essential in helping to improve the care and the safety of the care provided to patients.

There are three components of the technology environment:

1. Applications—the software used by administrative, clinical and support staff to process and store data, manage patients' records, provide information and knowledge
2. Hardware—the actual servers (virtual, cloud and physical), network connections and devices used to access and generate information
3. Networks—the wired or wireless connections that link the infrastructure together and enable accessibility of the applications and patient data

A healthcare facility requires these three components to function. While this may seem a very simplistic listing, these are essential to providing IT to a healthcare institution. And, while essential, with the rapid changes in technology and improvements in software, the sections of these components change frequently. Decreased access time and increased processor and hard drive speed enables the application to return processed data to the requesting clinician much more quickly. Technology changes are supporting—and changing the applications and the functions of the applications. The illustrations here are not intended to be a complete listing but to provide an overview.

Software in Healthcare IT

Software provides the face of healthcare IT. Hardware is not typically visible to the end users, but the applications that run on that hardware are. Use of the various software applications, along with changes in workflow and processes, can benefit the organization. The software is what the end user interacts with, using interfaces ranging from mobile devices to voice enabled assistants. There are a large number of applications, so we will discuss the major groups of applications and examine some of the newer ideas that are in the pipeline.

Clinical Applications

As with most specialties, healthcare IT has developed its own terminology and acronyms. Some of the terms seem interchangeable when, in fact, they do have different meanings. The EHR, the electronic medical record (EMR) and the PHR are examples of this. The EMR is the continuous, longitudinal electronic record in one specific setting—a provider's office, a hospital or a

home healthcare service. The EHR is a longitudinal record covering multiple settings over time.¹⁻³ The PHR is a medical record often created, edited, maintained and controlled by the patient, and possibly includes importation of clinical data from other sources. Often created online, it is accessible by providers when the patient invites providers to review information in the PHR using secure access.

Clinical applications support patient care wherever it is being delivered. The most apparent clinical application is the EHR. In some institutions, this is a one-vendor application; in others, it is a best of breed, with many different vendor applications performing different functions. The EHR is used by clinicians to document patient care, from medication administration to order entry, as well as to retrieve patient data from the lab or from radiology. The provider's office can send electronic prescriptions to the patient's pharmacy, as well as import and export data from an inpatient stay or outpatient testing from a health information exchange (HIE) system.

EHR systems can also execute algorithms for stratifying various clinical and operational activities. The data points that drive these prediction models can range from vital signs, lab results, to the number of no shows for outpatient visits. Enterprise EHR's can also include population health capabilities, clinical specialty modules and integration with outside regulatory and public health systems. The list of capabilities keeps growing as these systems mature.

The EHR interfaces with specialized systems in different departments. As an example, in the United States, radiology and pathology labs have specific requirements, with formatting and data display governed by different accrediting agencies, such as Clinical Laboratory Improvement Amendments (CLIA), the College of American Pathologists (CAP) and the American College of Radiology.^{4,5} In Europe, the European Cooperation for Accreditation⁶ covers laboratory certifications. Professional dietitians, case managers and social workers all have specific needs in software functionality, often dictated by professional or regulatory standards.

Some clinical areas, such as the perinatal areas (labor and delivery, nursery, neonatal intensive care and postpartum), the perioperative areas (preoperative unit, operating rooms and post anesthesia care unit), the critical care units, the outpatient centers for primary care and special functions like renal dialysis, have specialized documentation and information needs. The picture archiving and communication system (PACS) stores and displays images from ultrasounds to computed tomography (CT) scans and magnetic resonance imaging (MRIs). These systems require fine-resolution monitors, large storage drives, good bandwidth and large amounts of random access memory (RAM) for image display. Some of the major EHR vendors are able to support all the specialty areas; others do not and require the purchase and interface of a niche system specific to each specialty. The goal of all these systems is to communicate and exchange this patient health information, also known as interoperability. Interoperability is one of the most important attributes of clinical systems, since data should not

be entered into systems more than one time. It is essential that these systems exchange data with each other.

The availability of clinical data at the point of care has transformed how clinicians care for patients. They no longer need to go to the radiology department to look at MRIs or CT scans; those images can now be made available in the EHR application, saving time for clinicians, as well as money for the institution, since there are no films to create, store, or retrieve. Perinatal systems archive the fetal monitor strips electronically, saving thousands of dollars in charges for storage of paper fetal strips.

Administrative Applications

Administrative applications provide support for clinicians, as well as the administrative staff in an institution. These applications run the gamut from electronic time cards, intranet, payroll, staff competency record keeping and educational applications, to scheduling both staff for work shifts and patients for procedures and office visits. Bed management systems, which include staff from housekeeping and patient transportation, as well as clinicians, are very helpful in getting patients into a room as soon as possible. Popular applications in the last few years include equipment-tracking applications that use radio frequency identification (RFID) technology, thus saving staff time spent in hunting for needed equipment. Web-based applications that permit staff to bid for understaffed shifts are being implemented, reducing overtime labor costs and increasing staff satisfaction, as do systems that permit self-scheduling.

Financial Applications

Financial applications in healthcare IT cover all the features of any organization's financial needs, but possibly with more variables than most businesses have to entertain. From the solo provider's office to the multihospital, multi-provider health system, there is a need for financial systems. Multiple regulations govern how billing can be done, how bills are submitted and the details that have to be included with a bill, such as diagnosis codes and providers' licenses and billing numbers—the list is incredibly long. Systems have to handle charge posting via both orders and manual charge entry, payment posting and billing based on the providers. Insurance, coinsurance and deductibles have to be part of the calculations, as do revenue codes, supplies, tests and medications. Items that require a provider's order and cannot be billed to patients without an order must be distinguished from items that do not require an order and can be billed to patients. Statements need to be provided to patients and claims to insurance companies. These billing systems are commonly referred to as practice management systems.

A general ledger must accurately track charges, bills and payments. Payroll systems need to accept data from the electronic time card system and convert

it to salary costs, correctly matching hours worked, both regular and overtime, and calculate any overtime pay, holiday bonuses, shift differentials, or additional wages earned from professional certifications. It also has to track earnings for paid time off, usually based on the number of hours worked by the employee. The accounts payable portion of the software must also be in sync with all the other systems; financial systems have to communicate in real time. The supply chain mission and support has to include all methods of supply purchasing, as well as invoice payment, and ensure that they are linked correctly.

Consumer Applications

Consumers are becoming more and more involved in electronic records and their patient health information. Not infrequently, patients request electronic versions of their charts from providers. The importance of the consumer's relationship to the record and the information in that record is more apparent. While there used to be discussions about who owned the medical record, this seems to have been decided in the patient's favor. Most EHRs have a patient portal that permits the patient to view test results and clinical notes, ask for prescription refills and send the provider or the office staff a secure e-mail, as well as schedule an appointment. Some portals permit patients to add comments or request amendments to their EHR.^{7,8}

Some PHRs are stand-alone and are not connected with an institution's EHR. These applications may be web based, or an application installed on the user's computer or mobile app. In the United States, the Centers for Medicare & Medicaid Services (CMS) encourages the use of PHRs^{9,10} and provides a link to Blue Button®, a PHR initiative which originated through the Veteran's Administration and is now being offered through other healthcare organization patient portals. The National Committee on Vital and Health Statistics also provides detailed information on the advantages of a PHR.¹⁰ Convenient guides are helpful to patients around the world.¹¹ Web-based PHRs give the patient full control of the record's contents, and often offer the opportunity to import prescription medication history from national drug store chains or results from laboratories. According to Gherardi et al., PHRs are becoming very popular in Europe, the United Kingdom and Scandinavia.¹² Vendors are increasing their promotion about the PHR across Europe, the United Kingdom and China.¹³

Some healthcare organizations have partnered with web-based PHR vendors and uploaded records into patients' PHR applications from those healthcare institutions. Some healthcare insurers also provide the ability to create a PHR from their websites.¹⁴ In the United States, a national survey conducted by the California Health Care Foundation (CHCF) provides evidence that PHRs actually support patients in improving their own health.¹⁵ According to the survey, caregivers did note that PHRs were almost a necessity in maintaining knowledge and continuity of care for family members with multiple chronic conditions.

The numbers of patients using PHRs is growing rapidly, with the CHCF survey reporting that most patients want to use PHRs that their physician or insurer provides. The survey also identified security as the major stumbling block to PHR adoption, with patients looking for evidence that any information they enter into the PHR is completely secure. Most websites clearly provide information on how security and privacy of the patients' records is maintained. Most allow the patients to decide who can view their information, often by providing a secure URL or separate login and password for the healthcare provider. Patients have found that after establishing a PHR through their insurance company or other third-party vendor, information could not be easily transferred to a different PHR, resulting in the patients having to reenter the data in their new systems. PHR use has increased with the medical home and accountable care platforms, as they provide incentives for keeping patients healthy.¹⁶ In addition, the use of in-home health monitoring systems and wearable devices has also intensified the need for PHRs. In the United Kingdom, the NHS Summary Care Record (SCR) is an electronic summary of key clinical information (including medicines, allergies and adverse reactions) about a patient, sourced from the general practitioner (GP) record. It is used by authorized healthcare professionals, with the patient's consent, to support their care and treatment. If you are registered with a GP practice in England, your SCR is created automatically, unless you have opted out. 98% of practices are now using the system. The SCR is created automatically through clinical systems in GP practices and uploaded to the Spine. The Spine is a set of national services used by the NHS Care Record Service. In addition to the SCR, these include: The Personal Demographics Service (PDS), which stores demographic information about each patient and their NHS number. Patients cannot opt-out from this component of the spine and the secondary uses service (SUS), which uses data from patient records to provide anonymized and pseudonymised business reports and statistics for research, planning and public health delivery.¹⁷

Patients are also very interested in communicating electronically with their providers. According to the *Wall Street Journal*,¹⁸ doctors are far behind the rest of the world in using electronic communications, and either patient portals or secure messaging applications can provide security for this increasingly popular communication. Most patient issues can actually be addressed in e-mail by office staff, leaving only a few e-mails that the physician or nurse practitioner needs to address. Patients want the convenience of electronic communication with their providers, but at the same time, both sides of the communication have to be secure. While providers may not have the skill to set up secure communications, there are web-based and application-driven tools that will provide both security and convenience.

The requirement to be able to provide “human-readable” medical records in electronic format is something very new to healthcare. In the past, patients had to go to the health information management department, complete paperwork to request their own records and often pay a per-page fee for a

copy of the paper record. As an example, in the United States, Stage 1 of the CMS Meaningful Use requires that a copy of the medical record be available to the patient within 24 hours of the request.¹⁹ While it is not always easy to retrieve data from EHR systems, this requirement has to be fulfilled. Ensuring the EHR can provide this information, whether on a flash drive, or pushed out through an existing patient portal, is essential. In addition, regardless of the regulations, informed patients want copies of their records. Patients want to see their records, as determined by a group of researchers in the United States and Canada.²⁰

Clinical Business Intelligence (CBI) and Analytics

According to the HIMSS Clinical and Business Intelligence (CBI) Committee, CBI consists of “technologies, applications and practices for the collection, integration, analysis and presentation of clinical information, for the purpose of better clinical decision-making. In recent times, quality in healthcare is being shaped by evidence-based medicine and the proper utilization of data.”²¹ Tools of clinical and business intelligence can provide support to clinicians to improve patient safety and patient care, as well as analyzing operating room use and staff overtime patterns. Collecting—and reporting in a meaningful way—supports not only direct patient care, but also all aspects of healthcare, including predictive analytics. Hospitals want to show that they are providing high-quality, low-cost care for their patients; providers want to show that they are doing the same. Data and data analysis are the only keys to providing that information. More and more organizations around the world are implementing clinical and business intelligence, whether by using specific applications or by constructing data warehouses, to document the care they provide, as well as to show trends in patients’ conditions and document improvements in patients’ status and population health outcomes based on the care that they were given.

Hardware in Healthcare IT

Technology Infrastructure

The basis of any technology has to be the hardware systems that store data, run applications and connect those applications and tools together. The physical routers, switches and virtual and physical servers are some of the integral parts needed to connect clinicians, administrators, providers and patients to essential clinical systems, information and support. Firewalls, both physical and software based, along with virus scanning systems, protect the network from unauthorized access as well as maintain security of the information in the system.

Servers

While the vision that many people have of IT is a data center full of servers, this is no longer completely accurate. Most healthcare IT departments have virtual, physical and cloud servers. What application is installed on which type of server is determined by the vendors' recommendations, as well as the capabilities of the organization to support this technology. Servers are part of the most expensive equipment in a healthcare IT shop and must be managed well and appropriately. Cloud computing provides alternative cost-effective options for those organizations that may not have the appropriate space, resources, or desire to house and maintain their data in-house.

Data Storage

There are, depending on the type of patient, regulations on how long patient data must be maintained. Many healthcare organizations are simply resigned to keeping charts forever.

With paper records, that translates to a large amount of money to store stacks of paper that will probably never be looked at again. Health information management departments have looked for a less expensive and more reliable storage method. Historically, most organizations were forced to store paper charts off-site and have to order them when or if they are needed, thus adding transportation costs to and from the storage area to the record-keeping costs. Some health systems have a practice of scanning paper charts, and then appropriately disposing the paper chart. EHRs have reduced or eliminated the need for paper chart storage. Current practice, where data is stored, backed up and archived, is changing—often to the cloud. The cloud can provide room for storage, even when those storage needs may double every few years.

Mobile Devices

Hardware needs to be designed to support clinical workflow, and increasingly that means portable devices and wireless connectivity. Healthcare institutions are using workstations on wheels (WOWs) with wireless access, as well as smaller handheld devices. These workstations can be configured to meet end users' needs, from drawers for storage to holders for barcode medication scanners and locked drawers for security of medications. Workstations can also be designed for outpatient clinics and other clinical areas that have no need for drawers or scanners, while other workstations can have medical devices mounted on them. It is important to remember that while standardization may be a goal, one documentation device will likely not meet every area or end user needs.

The popularity of smartphones, and their increased functionality, is prompting end users to ask for similar devices for use in healthcare units. Smartphones are

one of the most popular handheld devices. Most EHR vendors have updated their applications for use on handheld devices. Devices with touchscreens are being configured for healthcare, with attention to the concern about maintaining good infection control practices while using equipment that is touched by gloved hands. Several devices, such as MRI scanners, employ touchscreens to program the examinations and review the images.

A major concern with any handheld device that connects to the institution's network is security, especially when end users actually bring their own devices (BYOD) to work. Prior to permitting staff's use of their personal devices in the clinical areas, it is important to establish a policy to ensure that protected health information (PHI) is safe, that the institution can wipe a device clean if it is compromised and that passwords are required to access the device. The decision to permit data storage on a personal device must be dependent on maintenance of the data's security.^{22,23}

Medical Devices

Many physiologic devices, such cardiac monitors, ventilators, some IV fluid pumps, medication pumps and vital sign monitors, have the ability to send out the data they obtain, often in Health Level Seven (HL7®) format. This integration with the EHR helps staff by decreasing data entry and transcription errors, as well as saving time. Depending on the EHR, this data could be sent directly to preconfigured fields, or a third-party device can be used to translate the data into EHR-acceptable format. It is important to require validation of the information by the clinician prior to permanently storing data in the EHR.

Laboratory devices can conduct tests and export the information to the EHR. Typically, radiologic images are stored in a PACS and viewed via a link from the EHR to the image in PACS or enterprise imaging system. Both areas have specific regulatory agencies that supervise the use of those devices and regulate them. As an example, in the United States, the Food and Drug Administration (FDA) regulates medical devices. Since so many of those devices have incorporated advanced technology, IT must be aware of the laws and regulations from the FDA that apply to hardware and software that is IT supported. In addition to radiologic images, any display of physiologic data, such as heart rhythms, fetal monitor tracings, ventilator or heart waveforms and any implantable device, such as an automatic cardiac defibrillator, are covered by the FDA. In addition, the FDA regulates mobile medical apps. Examples of these are applications that display fetal heart tracings or cardiac waveforms on physicians' cell phones.²⁴ The institution's biomedical engineering department must work closely with IT to maintain these important systems.

In Europe, the Parliament and the Council of the European Union have developed directives for medical devices and *in vitro* diagnostics. Canada has medical device regulations, as does Japan.²⁵ In Russia, the Ministry of Public Health and Social Development of the Russian Federation control medical

devices.²⁶ The World Health Organization (WHO) has published a large amount of information about medical device requirements on its web page.²⁷ According to the WHO, “65% of 145 countries have an authority responsible for implementing and enforcing medical device specific product information.”²⁸ There is discussion that the European Commission’s regulations for devices are not strong enough to really protect patients.²⁹

Networks in Healthcare IT

Network Infrastructure

The network, while still dependent on network cables, is increasingly connected using wireless points. Putting the information for clinicians at the point of care requires wireless access points, not hard or physical wires. Clinicians want data at their fingertips and do not accept the model of going to the patient’s room and then back to the nurse’s station to log in to the clinical system and retrieve results. Providers can now take the electronic chart with them to the patient’s room, where they can review lab results, x-ray reports and other tests with the patient. Wireless access points can support this workflow, permitting clinicians to work with the information they need when and where they need it. This wireless and cabled access supports more than just documentation stations. Virtual private networks (VPNs), voice over Internet protocol (VoIP) using fiber-optic cables and coaxial cables and supporting protocols, govern the connection of routers and switches. Local area networks (LANs) using Ethernet and a token ring, and wide area networks (WANs) using multiprotocol label switching (MPLS) or asynchronous transfer mode (ATM) are all in use, supporting the hardwired and wireless networks. VPN technology is a safer, more secure method of providing remote access to an organization’s network and servers. VPNs, using tunneling protocols and encryption, require authentication to block out unauthorized users.

There are guidelines and rules from regulatory bodies and professional organizations, and standards that require documentation about patients and the care given to those patients, as well as documentation of procedures. One of the major requirements of an EHR is that it must be able to support the documentation, order entry and lab results reporting required by regulations, professional standards and patient need. Ideally, that care is documented when and where it is provided, thereby reducing errors.³⁰

There are many areas in an organization that have cabled access to the organization’s intranet (internal) and Internet (external). Cabled access is more reliable and faster. Many institutions already have cable that was installed before wireless was within the price range and speed requirements of most IT departments. Clinical departments, as well as administrative and support services, usually have hardwired desktop computers. Some healthcare providers, especially in outpatient settings, have installed a desktop or fixed device in each

patient exam room. Specific clinical areas, such as radiology examination rooms, need special hardware, such as larger, high-resolution monitors and high-speed graphic cards that will support detailed images. In addition, hardware devices in patient care areas have to be cleaned with appropriate cleansing agents.

Communications

There are many different types of data communication protocols and media available in healthcare IT today, from the standard telephone landline with conferencing and video capabilities to various devices that use VoIP and broadband access. Data communication protocols allow information to transmit from one point or media to another. One of the most common examples would be the telephone. Some of the devices look like the same cell phones that are used outside the hospital, while some are clip-on, hands-free phones worn by staff members. As with other devices in use in clinical areas, such as tablets and medical devices, infection control is a major concern. Materials for these devices need to be antibacterial and cleanable. While some of these devices can send and receive text messages, there are concerns about the security of using text messages for patient orders and not all providers want to use text messages for orders. Bifurcated workflows such as these can result in missed patient care. Other examples of communication protocols would include broadband access, Ethernet and Wi-Fi for transmitting data across computer networks or accessing the Internet.

Interoperability and Standards

An important facet of all healthcare IT applications is the use of standards. Interoperability is essential to smooth functioning of healthcare IT, and systems that support standards ensure that functionality. Health Level Seven (HL7) is an international standard interface language used in healthcare,³¹ HL7 Fast Healthcare Interoperability Resources (FHIR®) is a next-generation standards framework that leverages the latest web standards, Digital Imaging and Communications in Medicine (DICOM®) is used as a standard for images³² and the Systematized Nomenclature of Medicine—Clinical Terms (SNOMED CT®) is the most comprehensive multilingual clinical healthcare terminology in the world,³³ while the International Statistical Classification of Diseases and Related Health Problems (ICD) provides diagnosis codes for most disease conditions.³⁴ In the United States, these codes, along with current procedural terminology (CPT®) codes, classify patients' diagnoses and the procedures they had and provide a link between each procedure and the diagnosis that required it.³⁵ In France, the International Society for Pharmacoeconomics and Outcomes Research (ISPOR) has developed charge codes for providers, including the correct prices that can be charged for a specific procedure.³⁶ These codes can be entered into the system by clerical staff as well as providers, and in most cases, these codes have

a large part in determining if an institution or provider will receive the maximum amount of reimbursement for performing a procedure or the minimum amount.

Interoperability is “the extent to which systems and devices can exchange data and interpret that shared data” and the “uniform movement of healthcare data from one system to another such that the clinical or operational purpose and meaning of the data is preserved and unaltered.”¹ With the current movement to exchanging patient data, regardless of the physical location of the patient and the patient’s home data, those standards, especially data formats, have become increasingly important and necessary.

Without standards, interoperability is impossible; without standards, healthcare IT would most resemble the Tower of Babel, with no system or device speaking the same language and resulting in duplicative effort and work from clinical and administrative staff as well as patient safety concerns. In the United States, governing standards are included in the Final Rule, published by CMS in August 2012, as well as the Advisory Board for Health Standards in Europe.³⁷

Included in the discussion of standards are nursing and other disciplines’ terminologies. These terms can be used by nurses, as well as other providers, including physicians, to document patient care. The need to standardize terms affects all parts of healthcare and especially impacts quality reporting. The use of standard words for documentation improves data, research and natural language processing (NLP), since it is clear what the standardized terms mean.

There are challenges to EHR interoperability throughout the world. The integration effort currently in place in Europe is improving the chances of adoption. This integration needs to move quickly, as the number of specialty systems is increasing. The specialty systems are often intended for use by only one discipline, moving away from an integrated EHR.³⁸

Data Integration

Data integration and the use of interface engines are essential in healthcare IT. Interface engines permit systems to be connected correctly. It is not enough to simply send data from one application to another—there are many rules that must be followed. If data does not go to the right patient’s chart, errors in the patient’s care, bill and final report could result. Interface engines in a healthcare IT environment really drive the systems, matching data and patients correctly in near real time. Without data integration and interface engines, a national health information network, connections to EHR’s with best of breed systems and EHR app integration using FHIR would not be possible.

Data Warehouses

Data warehouses are highly prevalent in today’s healthcare IT landscape. The value of being able to store and mine data from multiple sources, such as the EHR and ancillary systems, is clearly recognized. Storing data in one place—the

warehouse—from multiple sources allows it to be queried at the same time. Healthcare institutions have multiple requirements for submission of their data to different organizations, from the Bureau of Vital Statistics to the American Heart Association in the United States or the European Society of Cardiology. Often, these organizations require submission of the same quality improvement data elements, but just want it in a different format. The warehouse can support this type of quality reporting, as well as clinical research and analytics. Data mining can be used to identify populations at risk, search for patterns of illness and identify potential study candidates or those patient populations that are doing well.³⁹ Defining a data model, deciding if a data mart would be more helpful than a warehouse and determining how to search the warehouse are all decisions that should be made by an experienced database manager.

Privacy and Security

Maintaining patients' information, ensuring that it is kept private and secure, is the first charge for EHR administration. As an example, while patients' data has to be shared through HIEs and Regional Health Information Organizations (RHIOs), it must remain confidential. Increasingly, data regulations are including strong language about privacy and security, emphasizing that the EHR can and must be developed without compromising a patient's privacy. Systems, as part of their design, have to be able to provide the patient an accounting of disclosures. The system must be able to maintain levels of confidentiality. For example, a nurse or physician must be able to see the patient's laboratory results, but a nurse's aide using that same EHR should not be able to see that information.

While disclosures of information can be made to appropriate agencies, such as the patient's insurance provider, those agencies cannot be given complete access to the patient's record, but must be given the minimum amount of information necessary.

Ethically, healthcare providers have an obligation to keep any patient's information private and confidential. The healthcare professions have codes of ethics that clearly detail the nurse's and physician's obligation to protect the patient's information.⁴⁰

Summary

Understanding the basic foundations of healthcare technologies, applications and other tools used in connecting them together provides healthcare professionals and others allied to the field the ability to create, support and maintain healthcare information. Knowledge of these fundamental areas, as well as key issues and especially trends, is the basis of building and designing healthcare IT and supporting healthcare providers in their work of caring for patients in a safe, accurate and timely manner.